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Effect of Sorghum Hybrids on the Growth and Yield Parameters as Influenced by Different Nitrogen Levels under Rice - Fallow Conditions

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ABSTRACT

A field experiment entitled "Effect of Sorghum hybrids on the growth and yield parameters as influenced by different nitrogen levels under rice - fallow conditions"was conducted at Agricultural College Farm, Naira (India) in sandy loam soil during rabi 2016-17. The treatments comprised of combination of four sorghum hybrids and four nitrogen levels laid out in Split plot design with three replications. Sorghum hybrid CSH 25 and application of 120 kg ha^{-1} recorded the highest growth parameters as well as number of grains per panicle. Significantly higher grain yield was obtained with CSH 25 among hybrids and with 120 kg N ha-^{1}.However, stover yield was highest with hybrid CSH 15R at 120 kg ha^{-1}. Nitrogen uptake, agronomic efficiency, net returns and B:C ratio were also highest with CSH 25 at the highest level of N tried (120 kg ha^{-1}) and hence found promising for North Coastal Zone of Andhra Pradesh.

Key words: *Rice-fallow Sorghum, Hybrids, Yield, Agronomic efficiency, Nitrogen uptake and economics.*

INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench) is traditionally grown for food in semi-arid tropics of India and occupies an area of 6.32 m. ha with a total production of 6.03 m.t and a productivity of 1,004 kg ha^{-1}(ASG, 2011). As per the latest estimates, the crop is being grown under rice-fallows in an extent of 24,000 ha with a productivity of 6.5 t ha^{-12}. Of late, Sorghum is emerging as a potential alternate food, fodder and bio-energy crop owing to its tolerance to high temperature and drought there by making it suitable for different agro climatic zones of Andhra Pradesh. Sorghum cultivation is an emerging scenario in rice-fallows under zero tillage. In this changed scenario, farmers are now growing maize in assured irrigated areas as *rabi* crop. However, there is a prospective situation especially in areas having frugal water resources in rice-fallows of this zone for taking up sorghum as an alternate crop to pulses. For any crop, standardisation of agro techniques for realizing the higher yields is a prerequisite.

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Therefore, to identify a suitable hybrid and to arrive at a required dose of nitrogen and to work out their best combination for achieving higher yield of sorghum under rice fallow situation of this zone is considered as utmost priority and hence this study was undertaken.

MATERIAL AND METHODS

A field experiment was conducted during *rabi*, 2016-17 at Agricultural college farm, Naira, Srikakulam (Dt), A.P. The soil was sandy loam in texture with a pH of 7.42 and EC of 0.064 dSm^{-1}, medium in organic carbon (0.56%), low in available nitrogen (96 kg ha^{-1}), low in available phosphorus (12.4 kg ha^{-1}) and medium in available potassium (151 kg ha^{-1}). The experiment was laid out in Split plot design with three replications. The treatments comprised of four sorghum hybrids *viz.*, V_1- CSH 15R, V_2- CSH 16, V_3- CSH 25and V_4- MLSH 296 and four nitrogen levels N_1: 0 kg N ha^{-1}, N_2: 80 kg N ha^{-1}, N_3: 100 kg N ha^{-1} and N_4: 120 kg N ha^{-1}. A total rainfall of 8.0 mm was received in 2 rainy days during the growth period of rice fallow sorghum. A recommended dose of 80 kg P_2O_5 and 80 kg K_2O ha^{-1} was applied as basal and nitrogen was applied in the form of urea in three splits at 15 DAS, 60 DAS and at flowering. Data on growth parameters like plant height at harvest and dry matter accumulation at harvest, Number of grains per panicle, grain yield stover yield and harvest index, N uptake, agronomic efficiency and economics of rice fallow sorghum was calculated. Statistical analysis of all the data collected are carried out following the analysis of variance technique for split plot design as outlined by Panse and Sukhatame.

RESULTS AND DISCUSSION

The results (Table 1) indicated that the growth parameters *viz.*, plant height data of rice fallow sorghum varied significantly due to different hybrids and nitrogen levels while their interaction was found to be significant at harvest. CSH 15R (V_1) was significantly taller than all other hybrids except CSH 16 (V_2). Plant height recorded with CSH 25 (V_3) was on par with all the hybrids except CSH 15R (V_1). The lowest stature of sorghum was recorded with MLSH 296 (V_4). Plant height obtained was highest with N_4 (120 kg ha^{-1}) and was significantly higher than other levels of nitrogen except N_3(100 kg ha^{-1}) which it was comparable. Plant height recorded with N_2 (80 kg ha^{-1}) was in parity with all the levels of nitrogen doses except N_4. The lowest plant height was recorded with N_1 (0 kg ha^{-1}). Interaction effect at harvest revealed that plant height was highest with the hybrid CSH 16 at 120 kg N ha^{-1}(V_2N_4) and the lowest was recorded by MLSH 296 at 0 kg ha^{-1}(V_4N_1). The variabilities in the plant height can be attributed to the variation in the genetic constitution of different hybrids Increase in plant height might be due to the fact that nitrogen promotes plant growth and increases the number and length of the internodes which results in progressive increase in plant height.

Accumulation of dry matter pertaining to CSH 25 (V_3) was significantly superior to all the hybrids. Dry matter accumulation with CSH 16 (V_2) was found to be superior to all other hybrids except V_3, which was inferior to all the sorghum hybrids taken for trial. Dry matter accumulation at the highest nitrogen level (N_4) was significantly superior to all the other the levels of nitrogen levels tried. Dry matter accumulation obtained with the application of 100 kg ha^{-1} (N_3) was in parity with the application of 80 kg ha^{-1}(N_2). Both these nitrogen levels were significantly superior to, no application of nitrogen (N_1), which recorded the significantly lowest dry matter production among all the four levels of nitrogen tested in this experiment. Dry matter accumulation at harvest, was highest with the combination of hybrid CSH 25 at 120 kg Nha^{-1}(V_3N_4) and the lowest plant height was recorded by CSH 16 at 0 kg N ha^{-1}(V_2N_1) but was on par with MLSH 296 at 0 kg N ha^{-1} (V_4N_1) which was significantly inferior to all other combinations. Pushpendra singh *et al*.[9] has also reported that higher leaf area has led to the higher accumulation of photosynthates in hybrid CSH 25 at harvest stage. The improvement in morphological as well as physiological parameters due to fertilizer application might have resulted into better interception of radiant energy leading to higher photosynthesis there by higher accumulation of dry matter per plant.

Number of grains per panicle obtained with CSH 25 (V_3) was significantly higher than all the other hybrids except CSH 16 (V_2). Grains per panicle with MLSH 296 (V_4) was comparable with CSH 16 (V_2) and CSH 15R (V_1), which recorded the lowest among them (Table 1) .Highest nitrogen level (N_4) recorded significantly higher number of grains per panicle than all levels of nitrogen but was comparable with (N_3). Both these nitrogen levels were significantly superior to (N_2) and no application of nitrogen (N_1). Number of grains per panicle was highest with the hybrid CSH 16 at 120 kg N ha^{-1}(V_2N_4) which was on par with CSH 25 at 100 kg N ha^{-1} (V_3N_3) and superior to other interaction combinations. Higher number of grain per panicle might be due to increase in the fertility of flowers and increase in leaf area and duration which resulted into increase in supplying assimilates for the sink. Similar results were also reported by Mishra *et al*.[5].

The data (Table 2) on grain yield of sorghum indicated that yield obtained with CSH 25 (V_3) was significantly higher than all the other hybrids except CSH 16 (V_2) with which it was statistically comparable (Table 1). Grain yield recorded with MLSH 296 (V_4) was on par with all the hybrids except CSH 25 (V_3). The lowest grain yield was recorded with CSH 15R (V_1) among all the hybrids taken tested. Grain yield obtained at highest nitrogen level (N_4) was significantly superior to all the nitrogen levels tried. Yield obtained with the application of 100 kg ha^{-1} (N_3) was the next best treatment but was, however, comparable with the application of 80 kg ha^{-1} (N_2). Both these nitrogen levels were significantly superior to N_4 and significantly superior to no application of nitrogen (N_1), which recorded the significantly lowest grain yield among all the four levels of nitrogen tested in this experiment.

The Superiority of hybrid CSH 25 (V_3) in terms of yield under rice fallow conditions of sorghum can be attributed to its higher number of grains per panicle, dry matter accumulation at harvest as compared to other three hybrids. It has also the ability to put up the growth under low temperature conditions at early stages. Similar observations were reported by Mishra *et al*. [4] and Chapke *et al*.[2].The increase in the grain yields with enhanced N application could be ascribed to better plant growth and dry matter production due to higher photosynthetic area. This further supported by the fact that soil of the experimental field was low in nitrogen (96 kg ha^{-1}). These results are in corroboration with Madhukumar *et al*.[3], Mishra *et al*.[1, 6] and Vara Prasad *et al*.[10].

Stover yield obtained with CSH 15R (V_1) was significantly superior to all the hybrids. Yield of stover with CSH 25 (V_3) was found to be superior to all other hybrids except V_1, while yield with CSH 16 (V_2) was significantly superior to MLSH 296 (V_4). Stover yield at the highest nitrogen level (N_4) was significantly superior as compared to all the other the levels of nitrogen levels tried. Stover yield obtained with the application of 100 kg ha^{-1} (N_3) was the next best treatment but was, however, significant superior to 80 kg ha^{-1}(N_2). No application of nitrogen (N_1) recorded the significantly lowest yield among all the four levels of nitrogen tested in this experiment. Stover yield was highest with the hybrid CSH 15R at 120 $kgha^{-1}$ (V_1N_4) which was superior over other interaction combinations. The lowest stover yield was produced by MLSH 296 at 0 kg N ha^{-1}(V_4N_1). Higher stover yield with CSH 15R (V_1) might be owing to its tall growing nature as reflected by its highest plant height and also dry matter production. The same observations made by Patil[8] and Chapke *et al*. [2]. Highest stover yield recorded with the application of 120 kg N ha^{-1} might be due to the fact that nitrogen application increases the activity of cytokinin in plant which leads to the increased cell division and elongation. Madhukumar *et al*.[3] also made similar observations.

Harvest index data of rice fallow sorghum varied significantly among different hybrids and nitrogen levels while their interaction was found to be non significant (Table 1).Harvest index was highest with MLSH 296 (V_4) which was significantly higher as compared to all the other hybrids tried. Harvest index was highest with nitrogen level (N_2) as compared to all the nitrogen levels tried. Harvest index obtained with the application of 100 kg ha^{-1} (N_3), however, was comparable with the application of 80 kg ha^{-1} (N_2) and 120 kg ha^{-1}(N_4) levels.

Nitrogen uptake by grain and stover showed that CSH 25(V_3) was significantly highest than all other hybrids. It was followed by CSH 15R (V_1) and CSH 16 (V_2). The lowest grain and stover (Table 2) nitrogen uptake of sorghum was recorded with MLSH 296 (V_4).Nitrogen uptake by grain and stover at the highest nitrogen level (N_4) was significantly superior as compared to all the other the levels. Uptake with the application of 100 kg ha^{-1} (N_3) was significantly superior to 80 kg ha^{-1}(N_2) and no nitrogen (N_1). Both these nitrogen levels were significantly inferior to N_4 but were significantly superior to no application of nitrogen (N_1), which recorded the significantly lowest nitrogen uptake. Nitrogen uptake by grain was higher with the hybrid CSH 16 at 120 kg ha^{-1}(V_2N_4) and lower uptake was noticed with CSH 16 at 0 kg N ha^{-1} (V_2N_1). CSH 25 (V_3) could be efficient in exploring the nutrients exhaustively from the soil. The higher nitrogen content in grains compared to stover shows the efficient partitioning of nitrogen to the grains. Higher biomass production might be the most pertinent reason for the higher uptake of nutrients in the treatments which received higher levels of nitrogen. These results are in close conformity with the findings of Yakadri and Murali[11].

Computation and analysis of the data(Table 2) pertaining to the agronomic use efficiency (AEF) obtained with CSH 25 (V_3) was significantly highest than all the other hybrids followed by CSH 15R (V_1). AEF recorded with MLSH 296 (V_4) was on par with all the hybrids except CSH 25 (V_3). The lowest agronomic use efficiency was recorded with CSH 16 (V_2) and was least efficient among these hybrids. At highest nitrogen level (N_4) recorded highest AEF as compared to all the nitrogen levels tried, but was comparable with 80 kg ha^{-1} (N_2). AEF obtained with the application of 100 kg ha^{-1} (N_3) was significantly superior to no application of nitrogen (N_1), which recorded the significantly lowest AEF among all the four levels of nitrogen tested in this experiment. AEF was highest with the hybrid CSH 25 at 80 kgha^{-1} (V_3N_2) and the lowest was noticed with MLSH 296 at 80 kg N ha^{-1}(V_4N_2).

Net returns registered with CSH 25 (V_3) was higher than all the other hybrids except MLSH 296 (V_4) with which it was statistically comparable(Table 2). Net returns recorded with CSH 16 (V_2) were on par with all the hybrids except CSH 25 (V_3). The lowest returns was recorded with CSH 15R (V_1). B:C ratio of CSH 25 (V_3) was significantly superior to all the hybrids. B:C ratio with MLSH 296 (V_4) was found to be superior to all other hybrids except V_3, while B:C ratio with CSH 16 (V_2) was significantly superior to CSH 15R (V_1). Net returns and B:C ratio were obtained at highest nitrogen level (N_4) and were superior as compared to all the nitrogen levels tried. Returns and benefit cost ratio obtained with the application of 100 kg ha^{-1} (N_3) was comparable with the application of 80 kg ha^{-1} (N_2). Both these nitrogen levels were inferior to N_4 and significantly superior to no application of nitrogen (N_1), which recorded the significantly lowest of these parameters. Interaction was of hybrids and N levels for gross , net returns and benefit cost ratio were found to be non significant. The higher B:C ratio with CSH 25 and 120 kg N ha^{-1} might be due to more economic yield obtained at higher levels of nitrogen than lower level of nitrogen as also reported by Mishra *et al.*[5].

Hence from the above, it can be concluded sorghum can be successfully grown by choosing sorghum hybrid CSH 25and with application of 120 kg N ha^{-1} for the obtaining highest yield making it technically feasible and economically profitable proposition under the resource constrained rice fallow conditions of North Coastal Zone of Andhra Pradesh.

Table 1. Effect of different hybrids and nitrogen levels on growth and yield parameters of rice fallow sorghum

Treatments	Plant Height at harvest (cm)	Dry Matter production at harvest (kg ha^{-1})	Number of grains per panicle	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Hybrids						
CSH 15R	240.63	9503.75	2581	5023	15477	24.50
CSH 16	212.10	9872.44	2864	6068	12873	32.04
CSH 25	189.16	12542.83	2910	6841	13536	33.57
MLSH 296	185.60	8664.69	2675	6044	9222	39.59
SEm ±	1.40	193.00	54	294.0	169.4	1.25
CD (P=0.05)	4.96	680.85	192	1037	598	4.41
CV%	2.35	6.59	6.8	14	4.7	13.4
N-levels (kg ha^{-1})						
0	170.48	6953.28	1734	3436	8872	27.91
80	199.03	8854.39	2567	6296	11992	34.42
100	218.63	11759.56	3297	6751	14043	32.46
120	239.35	13022.48	3402	7491	16201	31.61
SEm ±	1.86	157.51	52	202	138.5	0.9
CD (P=0.05)	5.47	462.49	154	593	407	2.78
CV%	3.1	5.38	6.6	13	8.2	10.1
H x N						
SEm ±	2.80	386.004	108	588	338.8	2.5
CD (P=0.05)	11.30	987.143	325	NS	868	NS
CV%	3.98	5.38	6.6	13	8.2	10.1

Table 2. Effect of different hybrids and nitrogen levels on N uptake, agronomic efficiency of N and economics of rice fallow sorghum

Treatments	N uptake (kg ha^{-1})		Agronomic efficiency of N %	Net returns (Rs. ha^{-1})	B : C ratio
	Grain	Stover			
Hybrids					
CSH 15R	161.2	106.6	23.3	55456	1.33
CSH 16	166.5	103.9	19.5	68520	1.64
CSH 25	192.7	122.9	35.9	83057	2.00
MLSH 296	141.9	91.2	20.1	731412	1.75
SEm ±	5.9	3.8	3.3	3930	0.097
CD (P=0.05)	21.1	13.5	10.6	13866	0.34
CV%	12.5	12.5	12	10	4
N-levels (kgha^{-1})					
0	98.3	62.9	0	23044	0.55
80	138.5	88.1	33.3	72666	1.73
100	196.6	127.6	31.4	81270	1.95
120	228.9	146.0	33.7	103194	2.47
SEm ±	3.5	4.1	1.87	4601.54	0.110
CD (P=0.05)	10.3	12.1	5.5	13511	0.32
CV%	7.5	13.5	13	11	5
H x N					
SEm ±	11.9	7.6	6.6	7861	0.194
CD (P=0.05)	22.7	NS	10.2	NS	NS
CV%	7.5	13.5	13	11	5

REFERENCES

1. ASG, Agricultural *Stastistics at a Glance*. Directorate of Economics and Statistics, 2011. **4.9 (a-b):** 82-84 (2011).
2. Chapke, R.R., Mishra, J.S., Babu, S., Aruna, C and Patil, J.V., On farm evaluation of advanced sorghum hybrids in rice fallows under zero tillage. Current Advances in *Agricultural Sciences*. **6(2):** 180-182 (2014).
3. Madhukumar, M., Munirathnam, P and Srinivasa Reddy, M., Studies on the effect

of nitrogen fertilization on growth and yield of sorghum (*Sorghum bicolor*) varieties during post rainy (*maghi*) season. *The Andhra Agricultural Journal*. **60 (4):** 760-763 (2013).

4. Mishra, J. S., Subbarayudu, B., Chapke, R.R and Seetharama, N., Evaluation of sorghum (*Sorghum bicolor*) cultivars in Rice (*Oryza sativa*)-Fallows under Zero tillage.*Indian Journal of Agricultural Sciences*, **81 (3):** 277-279 (2011).
5. Mishra, J. S., Thakur, N. S., Pushpendra Singh, Kubsad,V. S., Kalpana, R., Alse, U. N and Sujathamma, P., Productivity, nutrient-use efficiency and economics of rainy- season grain sorghum (*Sorghum bicolor*) as influenced by fertility levels and cultivars. *Indian Journal of Agronomy* .**60(1):** 76-81 (2015).
6. Mishra, J.S., Thakur, N. S., Pushpendra Singh, Kubsad,V.S., Kalpana, R., Alse, U. N and Nemade, S. M., Tillage and integrated nutrient management in rainy-season grain sorghum (*Sorghum bicolor*). *Indian Journal of Agronomy*. **59(4):** 619-623 (2014).
7. Panse, V.G and Sukhatme, P.V. (Revised by Shukatme, P.V and Ambe, V.N.). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi. Pp: 100-174 (1985).
8. Patil, S.L., Performance of sorghum varieties and hybrids during p ostrainy season under drought situation in Vertisols in Bellary, India. *ejournal. icrisat. org*. **5(1):** 1-3 (2007).
9. Pushpendra Singh, Sumeriya, H. K and Solanki, N. S., Effect of fertilizer levels on productivity and economics of elite sorghum (*Sorghum bicolor* (L.) Moench) genotypes. *Madras Agricultural Journal*. **99(7-9):** 567-569 (2012).
10. Vara Prasad, P.V., George Mahama, David B. Mengel and Tesfaye T. Tesso., Influence of nitrogen fertilizer on growth and yield of grain sorghum hybrids and inbred lines. *Agronomy Journal*.**106 (5):** 1623-1630 (2014).
11. Yakadri, M and Murali, V., Effect of Planting Geometry and Nitrogen levels on growth and yield of sorghum. *ANGRAU Journal of Research* .**37(1&2):** 14-17 (2009).